480032

FLOOD INSURANCE STUDY

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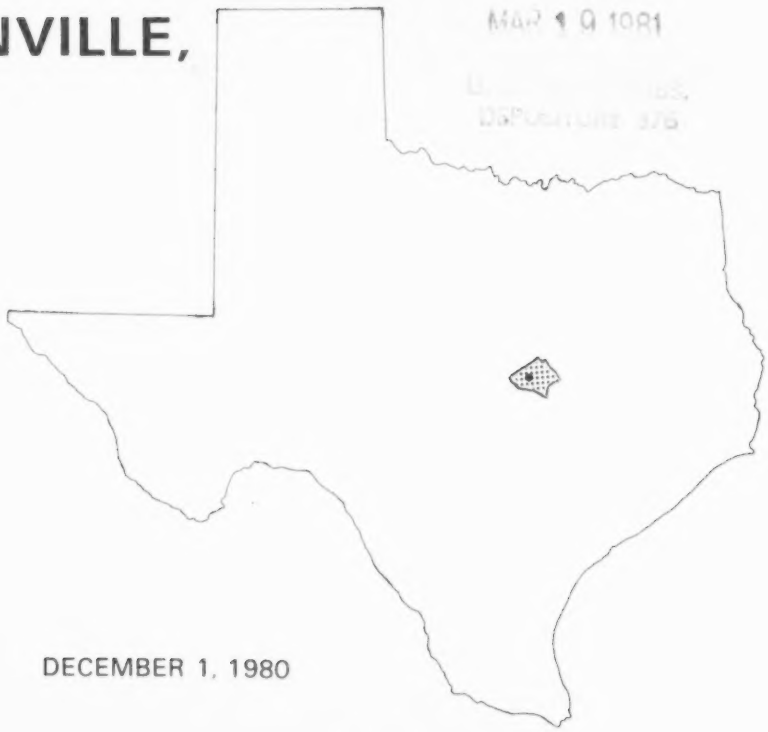
BELL COUNTY



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DECEMBER 1, 1980

federal emergency management agency
federal insurance administration

COMMUNITY NUMBER - 480032

FEMI-209.

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PUBLISHED SEPARATELY:

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Flood Insurance Rate Map

FLOOD INSURANCE STUDY
CITY OF NOLANVILLE, TEXAS

1.0 INTRODUCTION

1.1 Purpose of Study

The purpose of this Flood Insurance Study is to investigate the existence and severity of flood hazards in the City of Nolanville, Bell County, Texas and to aid in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. Initial use of the information will be to convert the City of Nolanville to the regular program of flood insurance by the Federal Insurance Administration (FIA). Further use of the information will be made by local and regional planners in their efforts to promote sound land use and flood plain development.

1.2 Coordination

A search for basic data was made at all levels of government. Conferences and meetings between representatives of the Soil Conservation Service (SCS) and personnel of the City Manager's staff were held to provide the SCS with information and asistance. The City Manager provided a boundary map showing latest incorporated limits and was the source for information on the community (Reference 1).

1.3 Authority and Acknowledgments

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968, as amended.

The hydrologic and hydraulic analyses for this study were performed by the Soil Conservation Service, U.S. Department of Agriculture for the Federal Insurance Administration under Interagency Agreement No. IAA-H-9-76. This work, which was completed in October 1979 covered all significant flooding sources in the City of Nolanville.

The results of the study were reviewed at a final meeting held on June 27, 1980.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the City of Nolanville. The area of study is shown on the Vicinity Map (Figure 1).

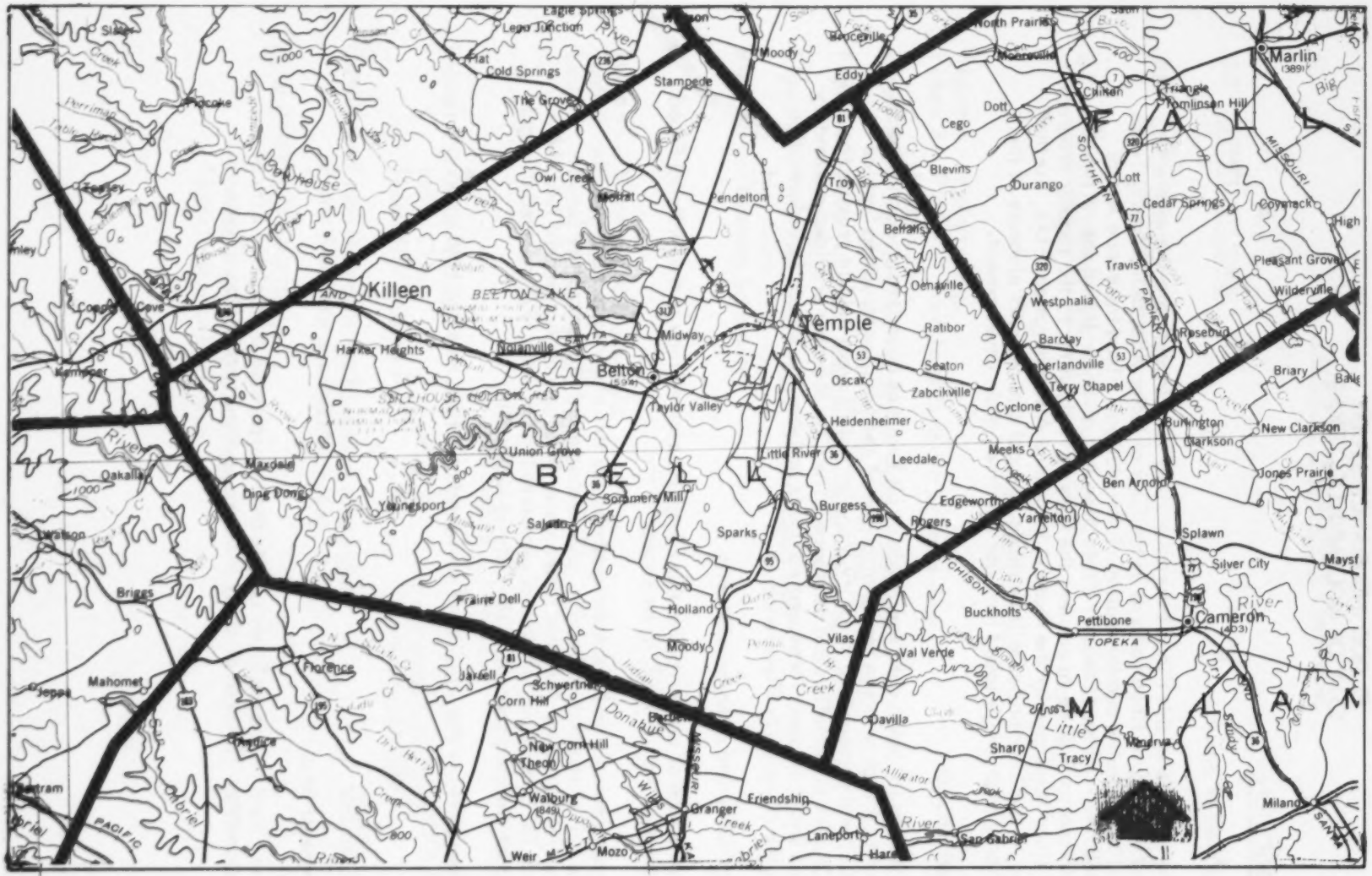


FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF NOLANVILLE, TX
(BELL CO.)

APPROXIMATE SCALE

VICINITY MAP

The city is drained by Nolan Creek and Nolanville Tributary, Nolan Creek flows from west to east through the central part of the city and empties into the Leon River approximately 1 mile east of the City of Belton in Bell County. Nolanville Tributary flows from north to south through the western part of the city and empties into Nolan Creek approximately ½ mile south of U.S. Highway 190. Altogether this study includes two distinct water courses: Nolan Creek and Nolanville Tributary. Both streams were studied by detailed methods.

The areas studied by detailed methods were selected with priority given to all known flood hazard areas, and areas of projected development or proposed construction for the next five years, through October 1984.

2.2 Community Description

The City of Nolanville is in the west central part of Bell County, Texas (Reference 2). The city is approximately 9 miles west of the City of Belton, county seat of Bell County, and approximately 8 miles east of the City of Killeen, in central Texas. The countryside around Nolanville is gently rolling to very rolling upland.

Nolanville got its start as a political entity in 1961. The major problem confronting the people of this area was that of determining the land use in this part of the county and control of local affairs. The City of Killeen was expanding at this time and many of the local people did not want to be a part of Killeen. An election was called and Nolanville was incorporated on March 8, 1961. The city was named after the man who first settled Nolan Valley in the 1800's.

There were 1,187 acres of land in the original incorporation and 322 people resided within the corporate limits. In 1979 there is approximately 1,400 acres of land within the city and 1,750 people reside in Nolanville.

The principal commercial activities in the city are typical of small central Texas cities. These include retail sales, transportation, and mineral resources (Reference 1).

The city and surrounding area is located in the Cross Timbers and Prairies Vegetation Area (Reference 3).

Prior to man's settlement, this area was characterized by a mid to tall grass prairie with motts of live oak scattered across the landscape. Woody vegetation, primarily elm and hackberry, also occurred along the stream courses. The principal grasses were little bluestem, big bluestem, switchgrass, Indiangrass, and sideoats grama (Reference 3).

With man's influence, the vegetation has changed considerably. The better soils have been converted to cropland or planted to introduced grasses such as coastal bermuda, common bermuda, and St. Augustine.

About 25 percent of the incorporated area of Nolanville is located on flood plain soils of the Frio Series along Nolan Creek. The Frio Series consist of deep, nearly level, clayey soils some of which are frequently flooded. Most of the built-up area of the city is located on soils belonging to the Lewisville Series which occupy about 23 percent of the incorporated area. The Lewisville Series consist of deep (greater than 5 feet), gently sloping, and undulating calcareous, clay soils. These soils were formed on stream terraces and on foot slopes below limestone hills. They are well drained, moderately permeable, have high available water capacity, and are well suited to the growing of crops. Most of the remainder of the built-up area of the city is located on soils belonging to the San Saba and Purves Series which occupy about 23 percent of the incorporated area. These soils are mainly calcareous clays which occur over limestone. They are generally 2 to 3 feet deep, moderately well drained, very slowly permeable when saturated, and rapidly permeable when dry and cracked. They are well suited to the growing of crops, and have gently sloping and undulating surfaces (Reference 4).

The Brackett Series occur in the more sloping parts of the area and consist of gently sloping to strongly sloping and rolling, calcareous, loamy, shallow soils underlain by soft limestone (Reference 4).

Other soil series present within the city limits in excess of 3 percent of the area include the Denton silty clay and Branyon clay (Reference 4).

The elevations in the city range from about 760 feet National Geodetic Vertical Datum of 1929 (NGVD) in the northeast part of the city to about 622 feet NGVD where Nolan Creek leaves the eastern most part of the city (Reference 5).

The average annual rainfall for the area based on the Temple gage with 95 years of record is 34.00 inches. The wettest month on the average is May having an average of 4.87 inches. The driest month on the average is July having an average of 1.61 inches (Reference 6).

The average annual temperature for the area based on the Temple gage with 87 years of record is 66.9 degrees F. The hottest month on the average is August having an average temperature of 85.1 degrees F. The coldest month on the average is January having an average temperature of 47.1 degrees F. (Reference 6).

2.3 Principal Flood Problems

All of the land in Nolanville is drained by Nolan Creek and its Tributaries. Nolan Creek and Nolanville Tributary originate outside the corporate limits and flow through the city. The large drainage areas, particularly on Nolan Creek, coupled with impervious paved surfaces of streets, subdivisions, and developments result in rapid runoff and high concentration. Small culverts under streets aggravate the flood problem. Flooding commonly occurs along all reaches of both of the streams studied. Small overflows occur during most years and cause minor damage. Larger floods, causing damage to residential and business properties, occur when the city receives, for example, 6.75 inches of rainfall in 24 hours. Records indicate that the city has a 10 percent chance of this rainfall occurring in any given year (Reference 7). See Figure 2-5 for photographs showing elevations of potential floods.

Flooding within the city has caused street closings on occasions. The intersection of Avenue H and 10th Street has to be closed due to flooding from Nolanville Tributary. The street closing mentioned is a normal occurrence in any given year. More street closings can be expected when the base flood occurs.

The last significant flood within the city was in 1973. This flood approached the base flood on Nolan Creek.

2.4 Flood Protection Measures

The City of Nolanville itself has no flood protection structures. The upper part of the Nolan Creek watershed does have flood protection structures built in it (Reference 8). These improvements were considered when water-surface profile elevations were determined. No concerted flood protection effort outside of the Nolan Creek Watershed Work Plan (Reference 8) is planned for the foreseeable future.

3.0 ENGINEERING METHODS

For flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Floods having recurrence intervals of 10-, 50-, 100-, and 500-years have been selected as having special significance for flood plain management and for flood insurance premium rates. The analyses reported here reflect current conditions in the drainage areas of the streams.

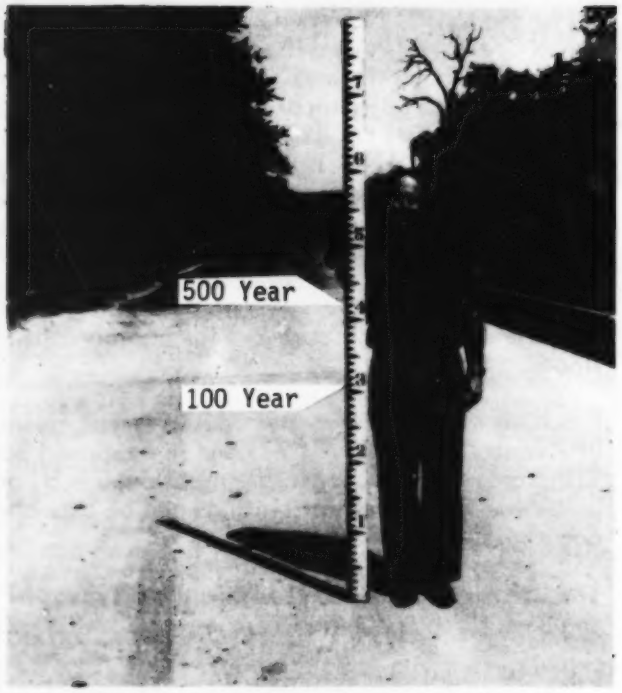


FIGURE 2: Potential flood heights at Main Street over Nolan Creek.

FIGURE 3: Potential flood heights on westbound lane of U.S. 190 on west side of Nolanville over Nolan Creek.

FIGURE 4: Potential flood heights at Avenue H over Nolanville Tributary.

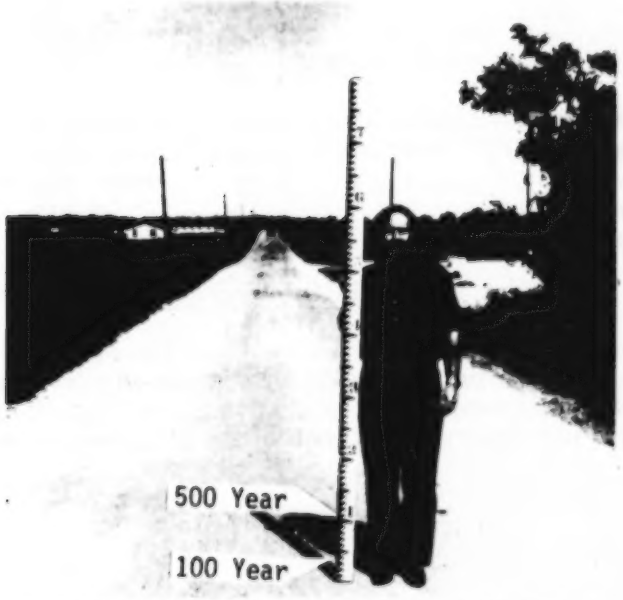


FIGURE 5: Potential flood heights at 10th Street over Nolanville Tributary.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish peak discharge-frequency relationships for floods of the selected recurrence intervals for each flooding source studied in detail in the community.

Hydrologic evaluations were based on synthetic frequency methods. Rainfall frequency data were obtained from U.S. Weather Bureau Technical Paper No. 40, Rainfall Frequency Atlas of the United States (Reference 7). Values greater than the 100-year frequency event were determined by extrapolation of data on standard log-log paper. For all streams within the City of Nolanville, peak discharge values for various frequencies were determined using SCS Computer Program For Project Formulation, Hydrology (Reference 9).

The peak discharge-drainage area relationships for the selected recurrence intervals are presented in Table 1, "Summary of Discharges."

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
NOLAN CREEK					
Cross Section A	64.83	16,703	23,886	27,425	34,784
Cross Section D	58.58	16,547	23,696	27,213	34,490
Cross Section E	57.16	17,102	24,145	27,567	34,671
Cross Section F	56.68	17,034	24,048	27,456	34,531
Cross Section G	55.62	16,880	23,832	27,209	34,220
Cross Section H	55.42	16,903	23,891	27,291	34,340
Cross Section K	53.75	16,749	23,681	27,038	34,028
Cross Section L	53.74	16,749	23,681	27,038	34,028
Cross Section Q	52.99	16,768	23,725	27,108	34,116
Cross Section S	47.43	16,644	23,557	26,942	33,947
NOLANVILLE TRIBUTARY					
Cross Section A	1.38	870	1,127	1,258	1,488
Cross Section D	1.30	758	1,038	1,153	1,349
Cross Section E	1.22	885	1,293	1,506	1,877
Cross Section G	1.11	1,012	1,547	1,860	2,406
Cross Section H	0.91	903	1,366	1,622	2,092

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of the streams in the community were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along each stream studied in detail.

Water-surface elevations of floods of the selected recurrence intervals were computed through use of the standard SCS computer program WSP-2 (Reference 10). Cross sections for the streams were field surveyed and were located at close intervals to bridges and culverts in order to compute the significant backwater effects of these structures.

The locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway is computed (Section 4.2), selected cross section locations are shown on the Flood Boundary and Floodway Map (Exhibit 3).

Channel roughness factors (Manning's "n") for these computations were assigned on the basis of field inspection of flood plain areas. Roughness values for the main channel of Nolan Creek range from 0.040 to 0.060 with floodplain roughness values ranging from 0.055 to 0.090. Roughness values for the main channel of Nolanville Tributary range from 0.045 to 0.055 with flood plain roughness values ranging from 0.065 to 0.075.

Flood profiles (Exhibit 1) were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals. The hydraulic analyses for this study were based on unobstructed flow. The flood elevations on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

Profiles for Nolan Creek and Nolanville Tributary were taken from the Flood Hazard Study for Nolan Creek and Tributaries (Reference 11).

All elevations are measured form National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in the study are shown and described on the maps.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

A prime purpose of the National Flood Insurance Program is to encourage state and local governments to adopt sound flood plain management programs. Each Flood Insurance Study, therefore, includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

4.1 Flood Boundaries

In order to provide a national standard without regional discrimination the 100-year flood has been adopted by the FIA as the base flood for purposes of flood plain management measures. The 500-year flood is used to indicate additional areas of flood risk in the community. For each stream studied in detail, the boundaries of the 100-year and the 500-year floods have been delineated using the flood elevations at each cross section; between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:24,000 with a contour interval of 20 feet (Reference 5). In cases where the 100-year and the 500-year boundaries are close together, only the 100-year boundary has been shown.

The boundaries of the 100- and 500-year floods are shown on the Flood Boundary and Floodway Map (Exhibit 3). Small areas within the flood boundaries may lie above the flood elevations and, therefore, not be subject to flooding; owing to limitations of the map scale, such areas are not shown.

4.2 Floodways

Encroachment on flood plains, such as artificial fill, reduces the flood-carrying capacity, increases the flood heights of streams, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent flood plain areas that must be kept free of encroachment in order that the 100-year flood may be carried without substantial increases in flood heights. Minimum standards of the FIA limit such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this report are presented to local agencies as minimum standards that can be adopted or that can be used as a basis for additional studies.

The floodway presented in this study was computed on the basis of equal conveyance reduction from each side of the flood plain. The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway was computed (Table 2).

As shown on the Flood Boundary and Floodway Map (Exhibit 3), the floodway widths were determined at cross sections; between cross sections, widths were interpolated and boundaries drawn. In cases where the floodway and the 100-year boundaries are close together, only the floodway boundary has been shown.

The boundaries were computed from hydraulic conditions only, with no consideration given to economic, legal, social, or political factors.

The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 6.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	REGULATORY (NGVD)	WITHOUT FLOODWAY (NGVD)	WITH FLOODWAY (NGVD)	INCREASE (FEET)
Nolan Creek								
A	79,735	1,656	13,713	2.00	645.6	645.6	646.6	1.0
B	79,845	1,768	11,890	2.31	647.5	647.5	648.5	1.0
C	79,955	1,720	11,686	2.35	649.2	649.2	650.2	1.0
D	88,920	894[2]	9,080	3.00	666.1	666.1	667.1	1.0
E	89,850	490[2]	3,820	7.22	668.9	668.9	669.9	1.0
F	93,400	871	6,488	4.23	676.6	676.6	677.6	1.0
G	94,960	326	4,574	5.95	678.8	678.8	679.8	1.0
H	96,480	614	4,587	5.95	683.5	683.5	684.5	1.0
I	97,130	733	5,891	4.63	685.8	685.8	686.8	1.0
J	97,230	756	7,117	3.83	686.7	686.7	687.7	1.0
K	100,430	433	3,912	6.91	693.8	693.8	694.8	1.0
L	103,320	1,018	7,419	3.64	699.3	699.3	700.3	1.0
M	103,525	1,218	6,167	2.95	700.9	700.9	701.9	1.0
N	103,630	1,335	12,015	2.25	702.6	702.6	703.6	1.0
O	103,737	1,382	13,476	2.01	703.6	703.6	704.6	1.0
P	103,870	1,500	14,187	1.91	704.6	704.6	705.6	1.0
Q	104,800	1,284	10,012	2.71	705.2	705.2	706.2	1.0
R	104,900	1,615	22,218	1.22	711.4	711.4	712.4	1.0
S	109,830	1,155[2]	10,406	2.59	714.5	714.5	715.5	1.0
T	109,950	1,402[2]	15,994	1.68	718.0	718.0	719.0	1.0

[1]Feet above mouth
[2]These widths extend beyond corporate limits

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF NOLANVILLE, TX
(BELL CO.)

FLOODWAY DATA

NOLAN CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	REGULATORY (NGVD)	WITHOUT FLOODWAY (NGVD)	WITH FLOODWAY (NGVD)	INCREASE (FEET)
Nolanville Tributary								
A	2,340	79	287	4.38	676.2	676.2	677.2	1.0
B	2,730	86	445	2.83	680.7	680.7	681.7	1.0
C	2,890	133	868	1.43	683.0	683.0	684.0	1.0
D	3,000	247	1,987	0.58	687.3	687.3	688.3	1.0
E	3,400	98	494	2.25	687.8	687.8	688.8	1.0
F	3,470	45	247	4.49	688.1	688.1	689.1	1.0
G	4,138	94	214	8.70	693.5	693.5	694.0	0.5
H*	6,420	60	321	5.80	714.5	714.5	715.5	1.0

[1]Feet above mouth
*Outside corporate limits

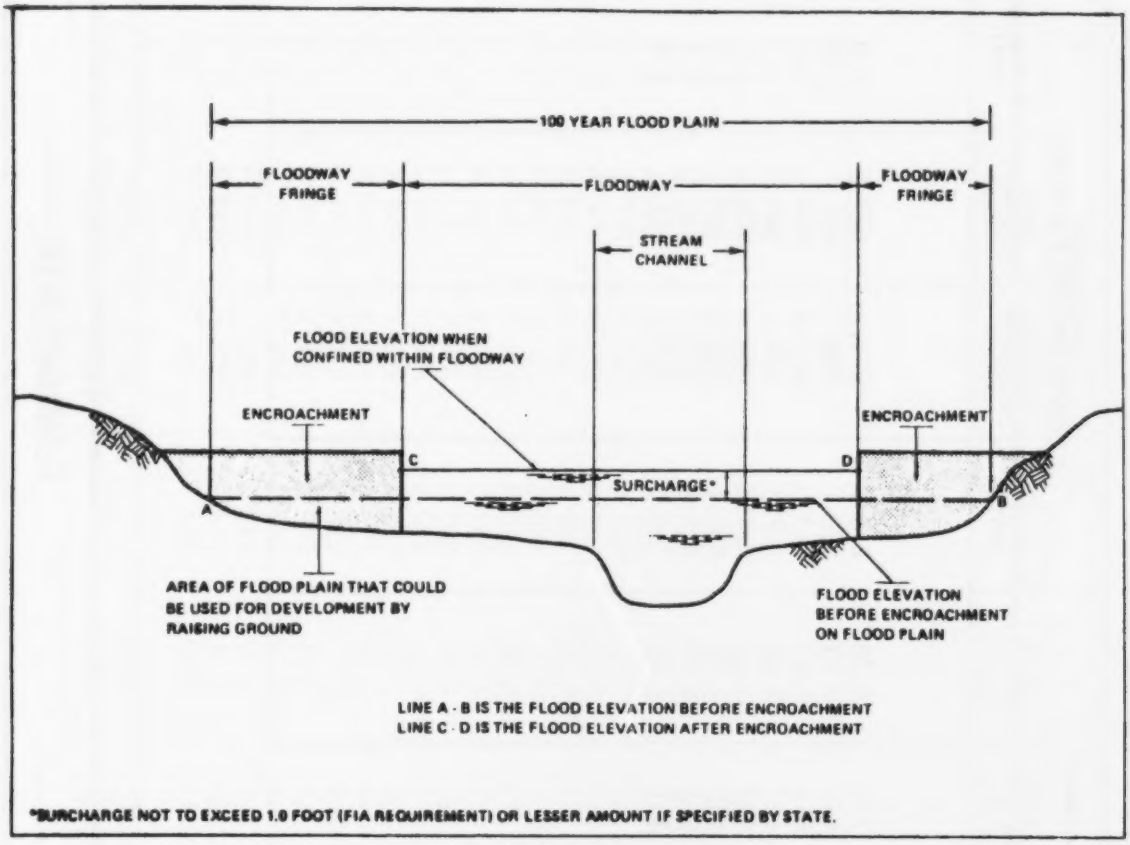
TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF NOLANVILLE, TX
(BELL CO.)

FLOODWAY DATA

NOLANVILLE TRIBUTARY


100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE A - B IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE C - D IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE NOT TO EXCEED 1.0 FOOT (FIA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

FLOODWAY SCHEMATIC Figure 6

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, the FIA has developed a process to transform the data from the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors (FHFs), and flood insurance zone designations for each flooding source studied in detail affecting the City of Nolanville.

5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference does not have a variation greater than that indicated in the following table for more than 20 percent of the reach.

Average Difference Between 10- and 100-Year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot

Four reaches meeting the above criteria were required for the flooding sources of the City of Nolanville. These include three reaches on Nolan Creek and one on Nolanville Tributary. The location of the reaches are shown on the Flood Profiles (Exhibit 1).

5.2 Flood Hazard Factors

The FHF is the FIA device used to correlate flood information with insurance rate tables. Correlations between property damage from floods and their FHFs are used to set actuarial insurance premium rate tables based on FHFs from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest one-half foot, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year water-surface elevations is greater than 10.0 feet, accuracy for the FHF is to the nearest foot.

5.3 Flood Insurance Zones

After the determination of reaches and their respective FHFs, the entire incorporated area of the City of Nolanville was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations.

Zone A:	Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations shown or FHFs determined.
Zones A2, A4, A6, A7:	Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations shown, and zones subdivided according to FHFs.
Zone B:	Areas between the Special Flood Hazard Area and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water control structure; also areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.
Zone C:	Areas of minimal flooding.

Table 3, "Flood Insurance Zone Data," summarizes the flood elevation differences, FHFs, flood insurance zones, and base flood elevation for each flooding source studied in detail in the community.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the City of Nolanville is, for insurance purposes, the principal result of the Flood Insurance Study. This map (published separately) contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by the FIA.

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FHF	ZONE	BASE FLOOD ELEVATION[3]
		10% (10 YR.)	2% (50 YR.)	0.2% (500 YR.)			
Nolan Creek							
Reach 1	0002	-3.1	-0.9	1.5	030	A6	Varies
Reach 2	0001,0002	-2.1	-0.6	1.1	020	A4	Varies
Reach 3	0001	-3.6	-1.6	2.3	035	A7	Varies
Nolanville Tributary							
Reach 1	0002	-1.2	-0.5	0.7	010	A2	Varies

[1]FLOOD INSURANCE RATE MAP PANEL
[2]WEIGHTED AVERAGE
[3]ROUNDED TO NEAREST FOOT-SEE MAP

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF NOLANVILLE, TX
(BELL CO.)

FLOOD INSURANCE ZONE DATA

NOLAN CREEK-NOLANVILLE TRIBUTARY

6.0 OTHER STUDIES

One flood hazard study for Nolan Creek and Tributaries (Reference 11) was checked for agreement with data in this report. No discrepancies in flood discharges or elevations were uncovered by this study. No other comparable reports are known to exist.

7.0 LOCATION OF DATA

Survey, hydrologic, hydraulic, and other pertinent data used in this study can be obtained by contacting the office of the Federal Emergency Management Agency, Insurance and Mitigation Division, Federal Center, Denton, Texas 76201.

8.0 BIBLIOGRAPHY AND REFERENCES

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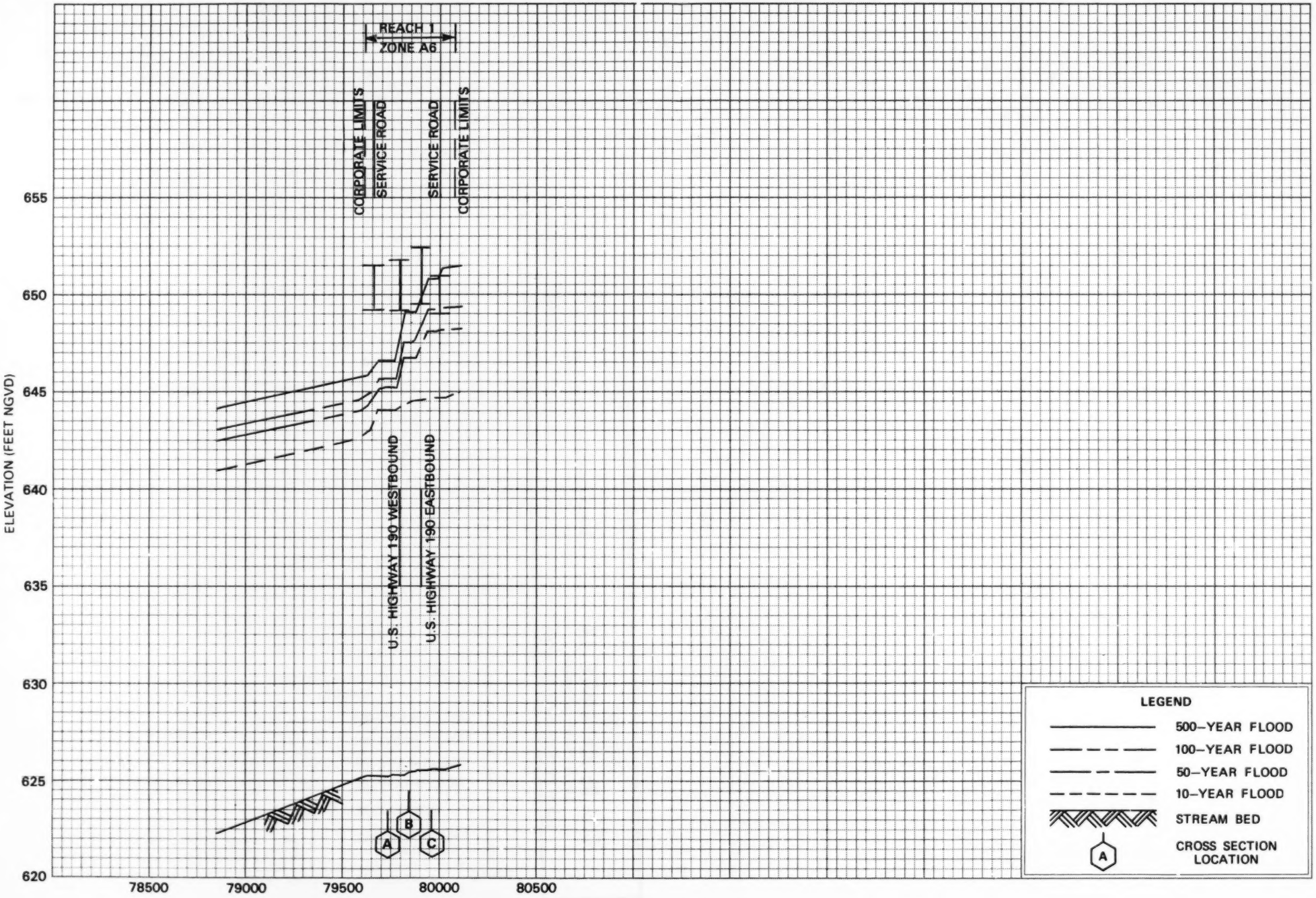

FLOOD PROFILES

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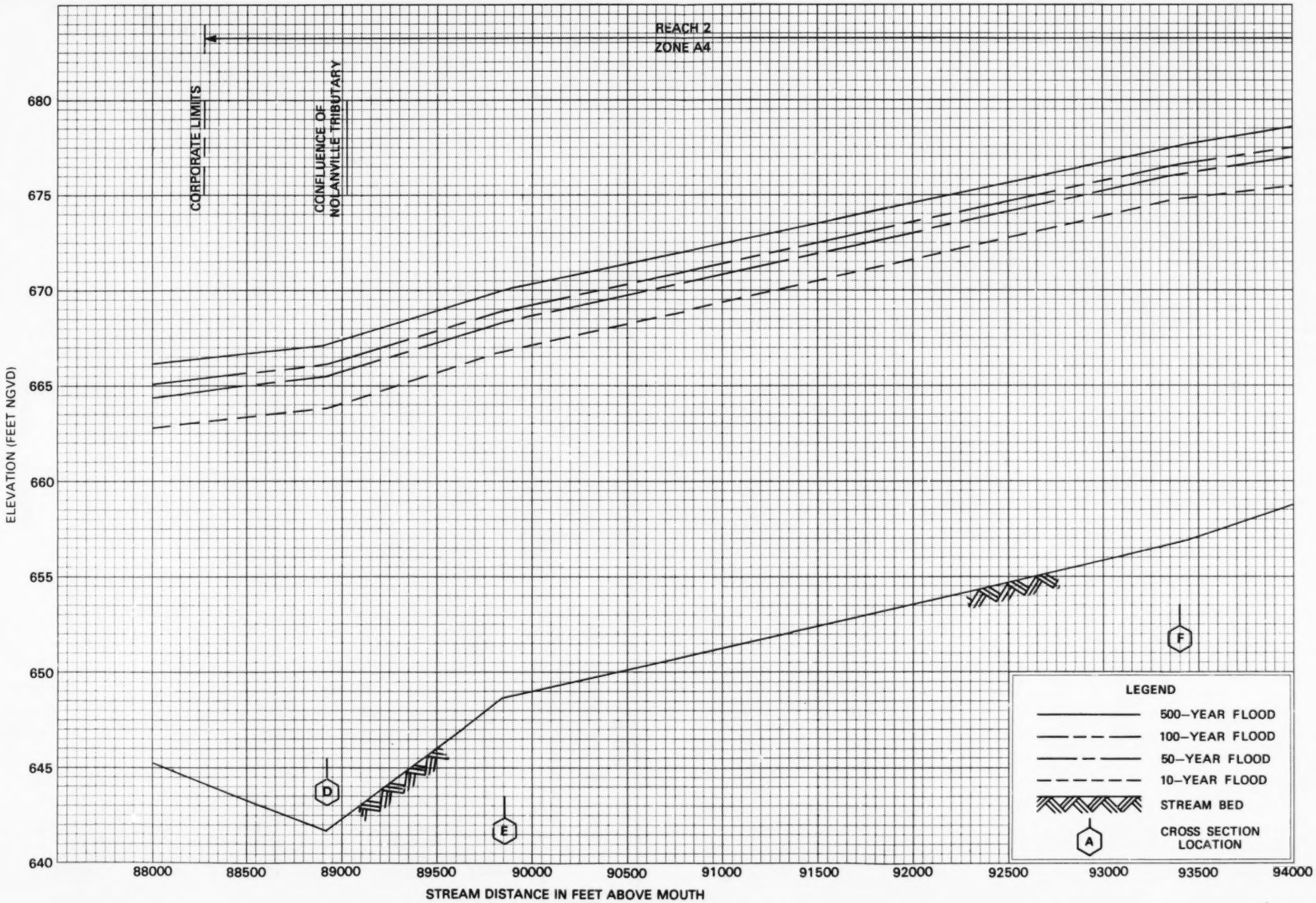

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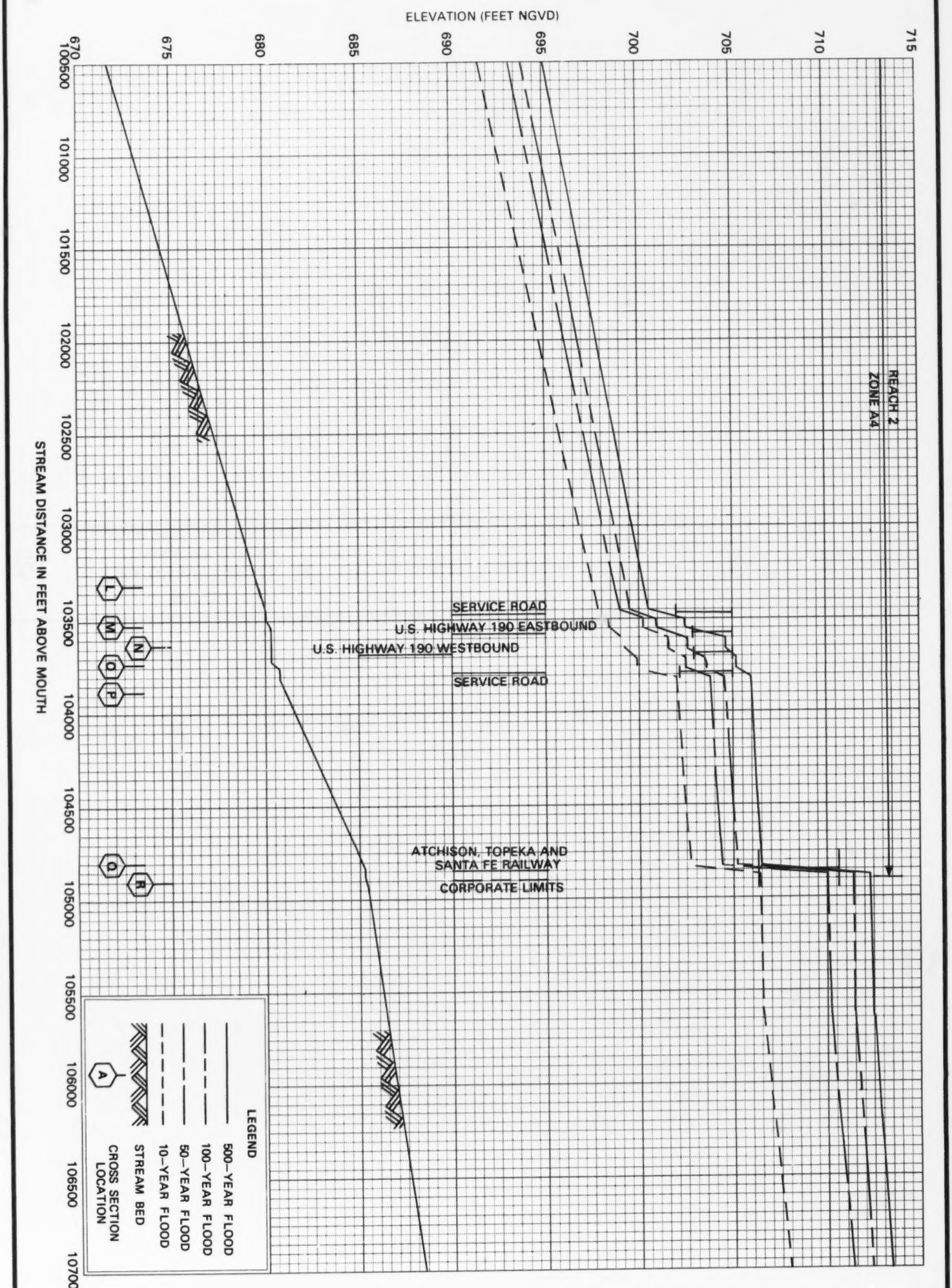

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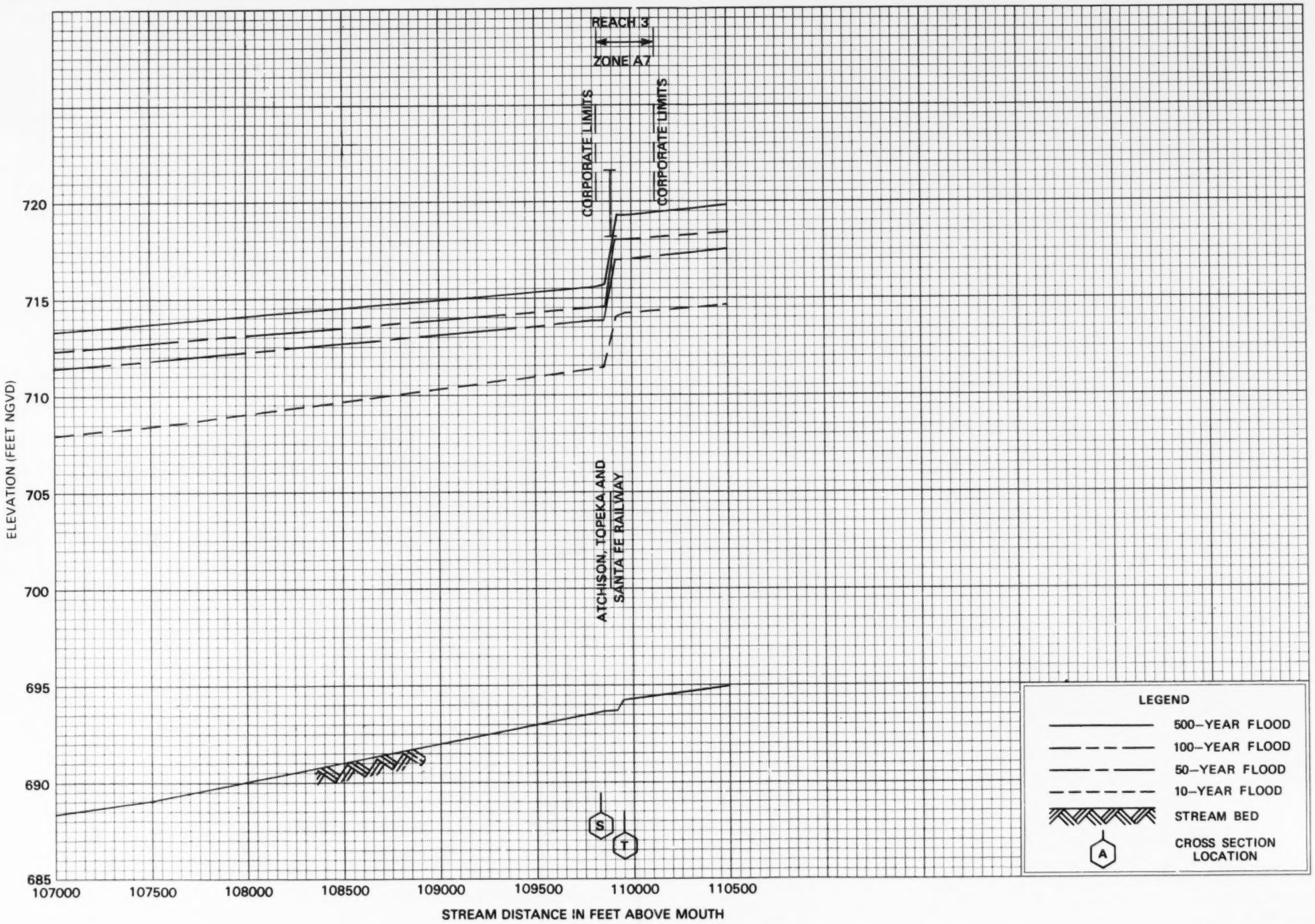

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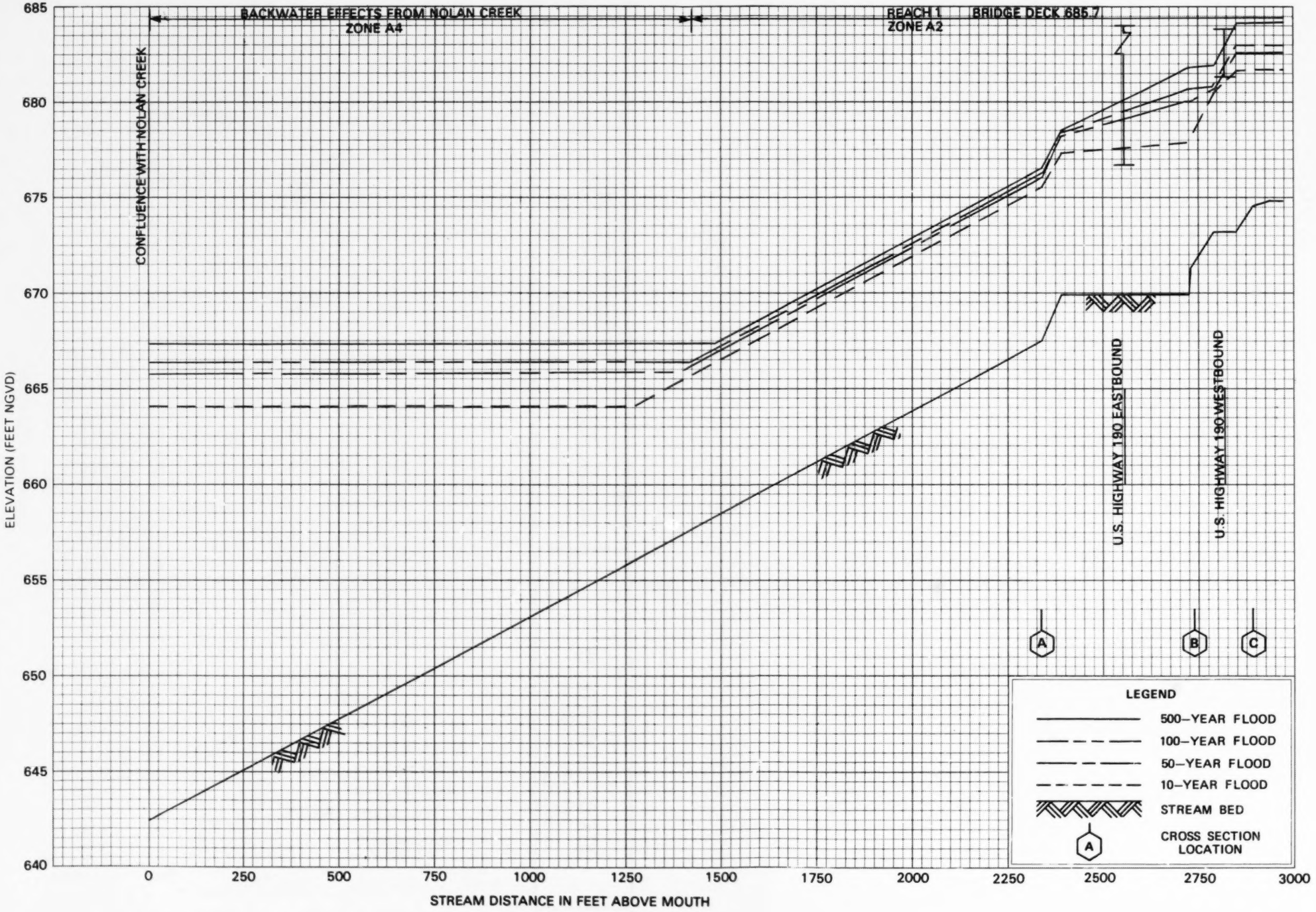

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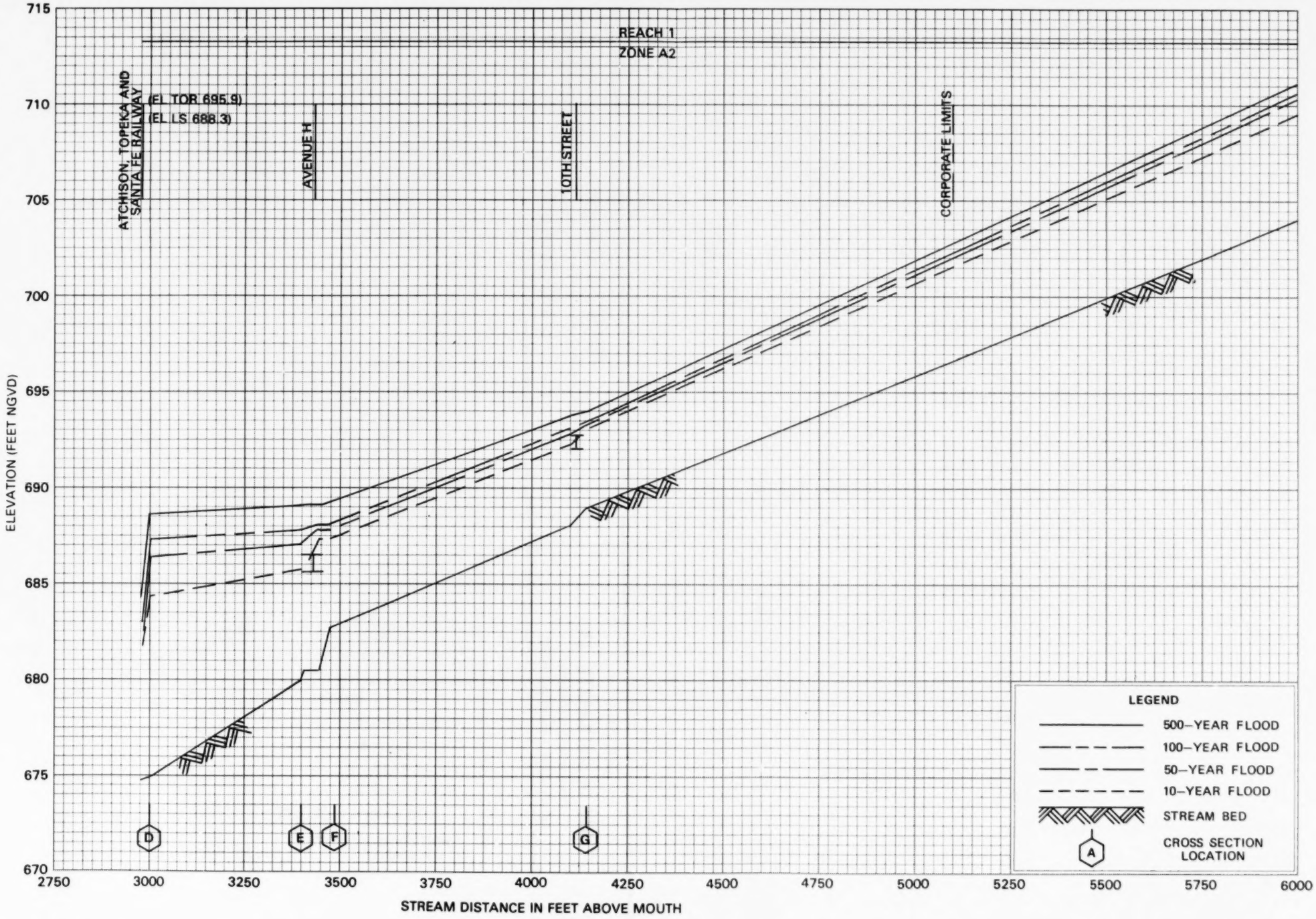

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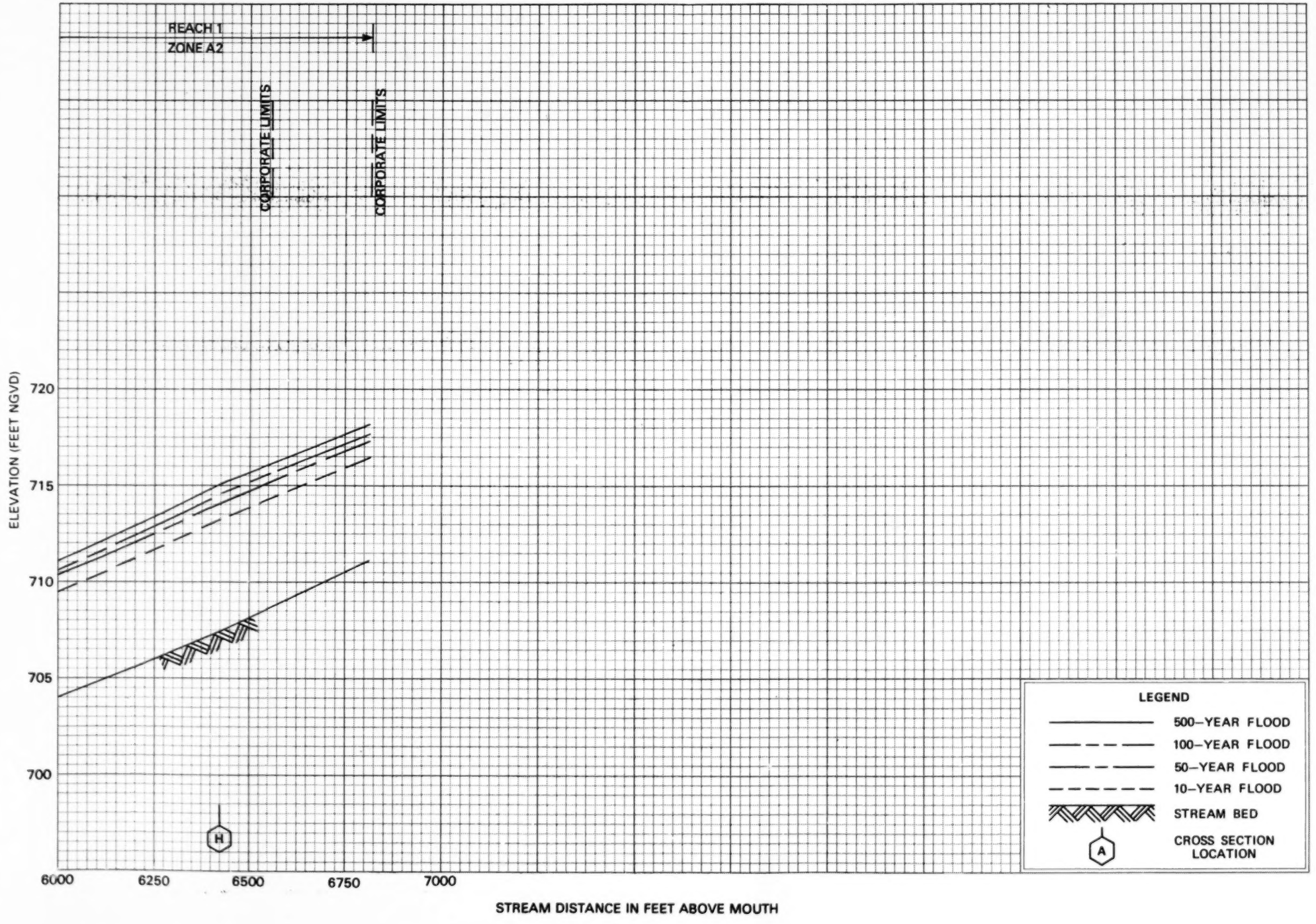

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